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All curvatures, especially the S-ones, are parallel with traumatropic curvatures. GASSNER rejects BRUNCHORST'S explanation (the action of the products of electrolysis, to which in essence SCHELLENBERG adheres) and that of RISCHAWI (accumulation of water on the convex side), claiming that galvanotropism is only a special case of traumatropism, in which the injury to the positive side is probably wrought by the passage of the current, as happens with other semipermeable membranes. Admitting that the electric current probably produces its effects by reason of migration of ions, GASSNER definitely declines to identify galvanotropism with chemotropism, since the latter itself may be only a modified form of traumatropism or indeed of osmotropism. Nor does he think the entry of hydroxyl ions on the anode side can account sufficiently for the injury, because by calculation their amount is infinitely small, and in an experiment rootlets of corn, containing red anthocyan, showed no change of color, though they curved well in a strong current. Rather he would ascribe the injury to the emigration of ions from the plasma.

The observations in these two papers are not so wide apart, nor are the interpretations so antagonistic as they at first appear.—C. R. B.

**Paleozoic botany.**—In his presentation of the present status of paleozoic botany, SCOTT<sup>14</sup> dismisses the lower cryptogams with the brief space (7 pages) which their recorded occurrence in the paleozoic strata warrants, and devotes the remainder of his article to the Vasculares. He adopts provisionally the division of vascular plants into two phyla, the Lycopsida and the Pteropsida, as proposed by JEFFREY. Under the Lycopsida are ranged the following classes: Sphenophyllales, Equisetales, Psilotales, and Lycopodiales. The first two classes are included under a group name, Articulatae, a propinquity of relationship thus being recognized, which was first pointed out by JEFFREY and subsequently by LIGNIER. In his treatment of the Sphenophyllales the author describes the features of the various types, already for the most part generally known from his textbook. One genus new to the general student is NATHORST'S *Pseudobornia* from the Upper Devonian of Bear Island, which is regarded by its author as the type of a special class, the Pseudoborniales. It is characterized by highly dichotomously divided and pinnatifid leaves, which have a certain resemblance to fern-fronds, a resemblance which is considered by SCOTT as of sufficient importance to indicate a certain affinity between the sphenophyllaceous stock and that of the Filicales. Unfortunately nothing is yet known of the internal structure of *Pseudobornia*. The author regards the characters of *Psilotum* and *Tmesipteris* as sufficiently distinct from those of the Lycopodiales to warrant their separation as a special class, the Psilotales. Indeed, he is of the opinion that their peculiar sporophylls find their nearest counterpart in those of the Sphenophyllales. The author even states that if he had to choose between lycopodineous and sphenophyllaceous antecedents for his new class he would choose the latter.

<sup>14</sup> SCOTT, D. H., The present position of paleozoic botany. *Progressus Rei Botanicae*, redigiert von J. P. Lotsy, pp. 139-217. 1906.

Under the Pteropsida are grouped the classes Filicales, Pteridospermeae, and Gymnospermeae, the two latter being regarded as of coordinate importance and constituting the Paleozoic Spermatophyta. The author in his discussion of the Filicales makes a strong stand against the tendency to include all paleozoic filicoid plants in the Pteridospermae. He points out that there is clear evidence that the Botryopterideae of RENAULT were true ferns. This is likewise in all probability true of other apparent filicinean remains, of unresolved affinity, characterized by the presence of annulate sporangia, for which the author proposes the form-generic name *Pteridotheca*. There is further good evidence in fruiting fronds referred to *Ptychocarpus*, *Asterotheca*, etc., with synangial sporangia resembling those of existing Marattiaceae, as well as in stems presenting the anatomical structure of *Psaronius*, for the existence of ferns like the Marattiaceae in paleozoic times.

The paleozoic seed-plants are included under two coordinate classes: the Pteridosperm(e)ae and Gymnosperm(e)ae, which are spelled with an unusual and perhaps superfluous *e*. The description of the Pteridospermae (Cycadofilices of PORONÉ) contains little which is not to be found in the author's lecture before the Vienna Congress. He states very clearly however his reasons for regarding the Pteridospermae as a group coordinate with the remaining gymnosperms as at present recognized: (1) the mega- and microsporangiate sporophylls were little modified from ordinary vegetative fronds; (2) the anatomical structure was more clearly fern-like than that found in any other gymnosperms. It may well be objected, however, that the Pteridospermae were essentially gymnosperms, that the Cycadophyta, taken as a group, present equally fern-like mega- and microsporophylls, and that the anatomical peculiarities of the Pteridospermae can nearly all be duplicated in the lower Gymnospermae. Whether or not the Pteridospermae stand as a distinct class coordinate with the remaining Gymnospermae, there can be no question that their discovery constitutes the principal advance in many years in our knowledge of the Spermatophyta. All botanists must be grateful to the author for his lucid and interesting account of paleozoic plants, which he has done so much to restore and rescue from oblivion. In looking over these pages, one is tempted to call the article an original compilation, so large and important, albeit not in any way disproportionate, a part, do the author's own investigations make of the whole.—E. C. JEFFREY.

**Cytological studies on the Cyanophyceae.**—Two contributions<sup>15, 16</sup> on the cytology of the Cyanophyceae have recently appeared, which add a few new features to an already much confused subject. GARDNER regards as the chief trouble which has obscured the truth for former investigators their "failure to discover a method which would clearly, definitely, and unmistakably differen-

<sup>15</sup> GARDNER, N. L., Cytological studies in Cyanophyceae. Univ. Calif. Pub. Bot. 2:237-96. pls. 21-26. 1906.

<sup>16</sup> GUILLIERMOND, A., Contribution à l'étude cytologique des Cyanophycées. Rev. Gén. Bot. 18:392-408, 447-65. pls. 9-13. 1906.